1. Describe the differences between exponential probability and theoretical probability.

2. What is the Law of Large Numbers?

3. Why would one thousand trials be more beneficial than 100 trials during a simulation?

Entrance Ticket   Name: __ANSWER KEY___
Lesson 2   Date: _____

1. Describe the differences between exponential probability and theoretical probability.

Theoretical is what is supposed to or expected to happen. Experimental is what actually happens when you conduct trials.

2. What is the Law of Large Numbers?

The more trials you conduct, the closer the theoretical and experimental probabilities are.

3. Why would one thousand trials be more beneficial than 100 trials during a simulation?

Law of Large numbers definition

Simulation Station

You and your three or four partners must complete seven stations on simulation and the devices used to create and execute simulations. You will have approximately five minutes at each station to complete the questions assigned for each station. The group number that you are assigned is the station you will begin with.

Group #_____

Station #1
Device: Coin

Part 1:

Kimberly is running for freshman class President. It is your job to simulate the outcome of the election. Use the coin provided and follow the directions below.

1. Each person will flip the coin five times. Heads (H) will represent a vote for Kimberly and Tails (T) will represent a non–vote for Kimberly.
2. Record your results in the table provided below. Remember each person flips the coin five times! Write each persons name in the column with their results.

Flip	Name:	Name:	Name:	Name:
1				
2				
3				
4				
5				

Total Number of Votes for (H) _____ /20

Total Number of Non Votes (T) _____ /20

- If Kimberly needs 40% of the votes to be in her favor in order to win, will she win the election based on your results above? Use mathematics to explain how you determined your answer.

- Is this enough information to predict if she wins the election from the freshman class and why?

- What other situations could we use a coin to predict the outcome?

Part 2:
Using two coins for a simulation.

Harry and Carrie are siblings; their parents are letting them get two pets. They will
receive one pet this month and one the next month. They are fighting about whether or
not to get a cat or a dog first. In order to settle their argument, they are flipping two
coins.

Coin #1 represents 1st pet   Heads represents a dog

Coin #2 represents 2nd pet   Tails represents a cat

- Each person in the group flips each coin 5 times and record the frequency of
  outcomes in the table below:

1st Pet	2nd Pet	Frequency
Dog	Cat	
Dog	Dog	
Cat	Cat	
Cat	Dog	

- Based on this simulation, which pet will they get first?

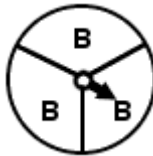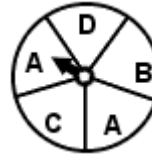- Name another situation in which you could use two coins to simulate an outcome.
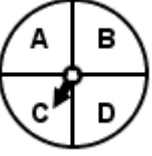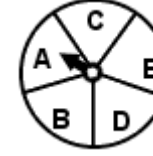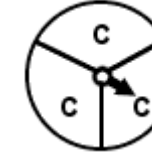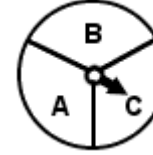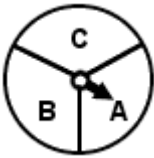
Device: Spinner

Complete the following 20 problems.
**Worksheet Courtesy of edHelper.com
Write the probability of spinning each letter.

1. The letter *C*. _____ out of _____	2. The letter *A*. _____ out of _____	3. The letter *B*. _____ out of _____	4. The letter *B*. _____ out of _____
5. The letter *E*. _____ out of _____	6. The letter *E*. _____ out of _____	7. The letter *A*. _____ out of _____	8. The letter *F*. _____ out of _____
9. The letter *C*. _____ out of _____	10. The letter *C*. _____ out of _____	11. The letter *B*. _____ out of _____	12. The letter *C*. _____ out of _____
13. The letter *G*. _____ out of _____	14. The letter *B*. _____ out of _____	15. The letter *D*. _____ out of _____	16. The letter *F*. _____ out of _____

| 17. The letter *C*. ____ out of ____ | 18. The letter *A*. ____ out of ____ | 19. The letter *F*. ____ out of ____ | 20. The letter *F*. ____ out of ____ |

1. What numbers was there an equally likely chance of each letter being chosen?

2. Which problems had a greater chance of a certain letter being chosen and why?

3. How could you use spinners to predict outcomes of different events? Give at least two examples and the rules for using the spinner.

Part2:

Use the four–sided spinner provided in order to create a simulation that will help you decide what restaurant to go to for dinner tonight. The four restaurant choices are Chili's, Fridays, Ruby Tuesday and Applebee's.

- Write the rule you will use for the spinner.

- Each person will spin 10 times to conduct the simulation. Write your responses in the table below.

Spin	Name:	Name:	Name:	Name:
1				
2				
3				
4				

1. What is the experimental probability for each restaurant?

Chili's   Fridays   Ruby Tuesday   Applebee's

2. Based on your simulation, what restaurant will you be eating at tonight?

Station #3
Random Number Table

http://www.mrs.umn.edu/~sungurea/introstat/public/instruction/ranbox/randomnumbersII.html

Above you will find the link to the random number table that is located at your station; you will need this table for this activity!

Kelly has the best big brother in the world, Josh. He takes her to the grocery store and buys her gumballs because he knows it is her favorite treat. She likes to watch it go down the slide! Today they are at the grocery store and as usual and Josh buys Kelly a gumball. Kelly wants to know what the chances are of her getting a pink gumball. Josh knows there are seven colors and each gumball has an equally likely chance of being chosen.

Help Josh figure out how to predict how many times he has to buy gumballs until he has a pink one.

1. How could you design a simulation to help Josh do this?

Out of all of the simulation devices to use, the most effective one would be a random number table. This is faster than the others because all you have to do is assign a number to each color.

There are seven colors of gumballs, you need to assign a number to each color listed below (hint: start with 1)

Red = 1
White
Blue
Pink
Green
Yellow
Orange

Now let's begin the simulation.

1. Place the random number table in front of you. Close your eyes and place your pointer finger on any spot on the paper.

Wherever your finger lands is the number you will begin with. Use the table below to help record your data.

Example: If your finger lands on 1 this represents a red gumball. You would place a tic mark next to the red gumball column and continue onto the next number to the right and continue until your group has **40** total tic marks.

Before you continue answer the following question…

2. Do you notice that it only includes the numbers 0–9? In the simulation you created you should have gone from #'s 1–7. What happens if in your line of numbers you hit a 0, 8 or 9?

Trial	Results	Frequency
Red		
White		
Blue		
Pink		
Green		
Yellow		
Orange		
Total		**40**

3. Which color gumball has the highest probability of being chosen based on your simulation?

4. Based on the data collected, what is the probability that Josh will buy Kelly a Pink gumball when they go to the grocery store?

5. What is the theoretical probability for each gumball chosen? Remember each has an equally likely chance of being chosen.

6. Compare your experimental probability to the theoretical probability in the table below.

Color	Experimental Probability	Theoretical Probability
Red		
White		
Blue		
Pink		
Green		
Yellow		
Orange		

7. Should the experimental and theoretical probability be close to each other?

8. How could we get a closer match between the theoretical probability and the experimental probability?

Station #4
Randomly Choosing out of a bag

You see in front of you a brown paper bag. DO NOT look inside of this bag! Inside there are several different colors of Jolly Rancher candy. Follow the directions step by step in order to complete this station successfully.

1. Each person in your group will pick a candy out of the bag 10 times and record the results in the table provided below: (Hint: Make sure your column has a total of ten trials.)

Color Jolly Rancher	Person 1	Frequency	Person 2	Frequency	Person 3	Frequency	Person 4	Frequency
Red								
Green								
Purple								
Yellow								
Orange								
Total		10		10		10		10

2. Total the number of each color Jolly Ranchers chosen:
   Total Red: Total Green: Total Purple:

   Total Yellow: Total Orange:

   Still not allowed to look in the bag!!!

3. Combine all of your teams' trials, and calculate the <u>experimental probability</u> of choosing each color Jolly Rancher. Use the totals from step 2 to help you.

   Red: Green: Purple: Yellow: Orange:

4. Now, LOOK INSIDE THE BAG. Take out all of the candies and write down the <u>theoretical probability</u> for each of the candies.

   Red: Green: Purple: Yellow: Orange:

5. How did the theoretical probability compare to the experimental probabilities? It may help to re–write the fractions in #3 and #4 as percentages.

Station # 5

Number Cube

Part 1:

You have a big date tomorrow night with the person who you have had a crush on all year. It is very important that you look your absolute best! However, you have so many great outfits it is hard to choose which one to wear on the date. You need to decide between 6 shirts and 4 bottoms. Your best friend gave an idea to use a 6–sided number cube to help decide on the outfit you will wear tonight. You will roll the number cube a total of 20 times to help you decide first on the shirt then on the bottom. (Luckily everything goes together so you will match). Whatever shirt and bottom are rolled the most are the two pieces you will wear tonight.

- Explain the rule you would use when rolling the number cube to decide what to wear tonight.

- Are there any numbers on the number cube that you will disregard and not use in the simulation? If so, why?

- Each group member will roll the number cube 5 times for each piece of clothing, the shirt and the bottom.

Record your results in the table below

Shirt & Bottom # Assignments	Person 1		Person 2		Person 3		Person 4	
	Shirt	Bottom	Shirt	Bottom	Shirt	Bottom	Shirt	Bottom
1								
2								
3								
4								
5								
6								

- What shirt and what bottom will you wear for your date tonight?

Part 2:

Create <u>two</u> new simulations that could be used in a real life situation.
- Simulation 1 *uses all of the numbers* on the 6–sided number cube.
- Simulation 2 *does not use all of the numbers* on the number cube. Please be sure to explain what happens if you land on a number that is not assigned to something in your simulation

Station #6
Deck of Cards

Larry is going to Bubba's Buffet for dinner. He loves this buffet and always has a hard time deciding what to eat. Your job is to help Larry create a simulation using his lucky pack of playing cards that he keeps in his back pocket at all times.

He has four categories of food at the buffet to choose from. Larry wants to pick one item from each category. They are as follows.

Entrees	Side Items	Salad Dressings	Desert
Steak	Baked Potato	Ranch	Chocolate Cake
Chicken	French Fries	Blue Cheese	Apple Pie
Pork Chops	Rice	Italian	Brownies
Hot Dog	Broccoli	French	Sundaes
Hamburger	Corn on the Cob	Thousand Island	Chocolate Pudding
Pizza	Baked Beans	Caesar	Strawberry Shortcake
Spaghetti	Mashed Potatoes		Cheesecake
Roast Beef	Grits		
	Garlic Bread		
	Steamed Vegetables		

You need to use his lucky playing cards to help him decide what items he will get on his first trip to the buffet.

Part 1:
1. How would you create the simulation so that he only gets one item from each category? (Hint: use the card suits Spades, Hearts, Diamonds and Clubs) The first column is started for you, please continue from there and fill in the other three columns.

Record your rules below:

Hearts = Entrees			
2 = Steak			

2. From question #1 does each item in the category have an equally likely chance of being chosen?

3. What if Larry shuffled all of the cards together and chose four cards randomly from the pile, how will this effect his buffet selection?

Part 2:

Now, you will simulate what Larry will eat for his first trip up to the buffet. Each person in the group needs to conduct five trials. That means take one card from each pile, replace the card after you recorded the result, shuffle the deck and begin again.

Remember to keep each category of cards separated so there is one item from each category selected!

When you are finished there should be 20 total items chosen from each category.

Entrees	Frequency	Side Items	Frequency	Salad Dressings	Frequency	Desert	Frequency
Steak		Baked Potato		Ranch		Chocolate Cake	
Chicken		French Fries		Blue Cheese		Apple Pie	
Pork Chops		Rice		Italian		Brownies	
Hot Dog		Broccoli		French		Sundaes	
Hamburger		Corn on the Cob		Thousand Island		Chocolate Pudding	
Pizza		Baked Beans		Caesar		Strawberry Shortcake	
Spaghetti		Mashed Potatoes				Cheesecake	
Roast Beef		Grits					
		Garlic Bread					
		Steamed Vegetables					

Based on your simulation,
1. What Entrée will Larry eat first?

2. What Side item will Larry eat first?

3. What Salad Dressing will Larry eat?

4. What desert will Larry Eat?

Station # 7

Number Cube

Materials: miniature cars, a race board, and number cube

Part 1: ** Do ten trials for each experimental probability question**

Given a race board and different colored cars, you will play against a partner to win the race in **1 or 3** moves (read directions in each question–it changes!). Note you may only move by rolling a number cube, and there are specific rules, which change in each question! Complete the following four questions:

1. If the blue car is allowed to move on rolls of 2, 5, and 6 and the red car is allowed to move on rolls of 1, 3, and 4 which car is more likely to finish a 3 step race first?

    a. What is the theoretical probability the red car will finish first? _____

    b. What is the experimental probability of the red car finishing first? _____

    c. What is the theoretical probability that the blue car will finish first? _____

    d. What is the experimental probability of the blue car finishing first? _____

    Explain your answers above.

2. If the red car is allowed to move on rolls of 1 and 6 and the blue car is allowed to move on rolls of 2, 3, 4, and 5 which car is more likely to finish a 1 step race first?
    a. What is the theoretical probability the red car will finish first? _____

    b. What is the experimental probability of the red car finishing first?

    _____

    c. What is the theoretical probability that the blue car will finish first? _____

    d. What is the experimental probability of the blue car finishing first? _____

    Label and Show Your Work.

3. If the blue car is allowed to move on rolls of 3 and the red car is allowed to move on rolls of 1, 2, 4, 5, and 6 which car is more likely to finish a 1 step race first?
    a. What is the theoretical probability the red car will finish first? _____

    b. What is the experimental probability of the red car finishing first? _____

    c. What is the theoretical probability that the blue car will finish first? _____

    d. What is the experimental probability of the blue car finishing first? _____

    Label and Show Your Work

4. If the red car is allowed to move on rolls of 1 and the blue car is allowed to move on rolls of 2, 3, 4, 5, and 6 which car is more likely to finish a 1 step race first?
    a. What is the theoretical probability the red car will finish first? _____

    b. What is the experimental probability of the red car finishing first?_____

    c. What is the theoretical probability that the blue car will finish first? _____

    d. What is the experimental probability of the blue car finishing first? _____

    Label and Show Your Work

Teacher note afterwards:
  o Ask the class what they think caused the discrepancies in their experimental results and their theoretical results.
  o Ask the class if they believe performing the experiment more times would make their experimental results closer to the theoretical results.
  o Ask them how long they think it would take them to perform that experiment 10,000 times.
  o Use this website in conjunction with Station #7 http://www.shodor.org/interactivate/activities/race/index.html

Simulation Station

You and your three or four partners must complete six stations on simulation and the devices used to create and execute simulations. You will have approximately five minutes at each station to complete the questions assigned for each station. The group number that you are assigned is the station you will begin with.

Group #_____

Station #1
Device: Coin

Part 1:
Kimberly is running for freshman class President. It is your job to simulate the outcome of the election. Use the coin provided and follow the directions below.

3. Each person will flip the coin five times. Heads (H) will represent a vote for Kimberly and Tails (T) will represent a non–vote for Kimberly.
4. Record your results in the table provided below. Remember each person flips the coin five times! Write each persons name in the column with their results.

SAMPLE

Flip	Name:	Name:	Name:	Name:
1	H	T	H	H
2	H	H	T	H
3	T	T	T	T
4	H	T	H	H
5	T	H	T	H

Total # Votes for (H)   11 /20

Total # Non Votes (T)   9 /20

- If Kimberly needs 40% of the votes to be in her favor in order to win, will she win the election based on your results above?
  Yes

- Is this enough information to predict if she wins the election from the freshman class and why?
  No, because not enough trials. We need more because we will get better results Law of Large Numbers.

- What other situations could we use a coin to predict the outcome?
  Sports team win or lose a game, a baby born is a boy or girl, etc.

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Part 2:
Using two coins for a simulation.

Harry and Carrie are siblings, their parents are letting them get two pets one this month and one next month. They are fighting about whether or not to get a cat or a dog first. In order to settle their argument, they are flipping two coins.

Coin #1 represents 1st pet   Heads represents a dog

Coin #2 represents 2nd pet   Tails represents a cat

- Each person in the group flip each coin 5 times and record the frequency of outcomes in the table below:

1st Pet	2nd Pet	Frequency
Dog	Cat	8
Dog	Dog	2
Cat	Cat	5
Cat	Dog	5

- Based on this simulation, which pet will they get first? Second?
      First pet will be a Dog and the second pet is a Cat
- Name another situation in which you could use two coins to simulate an outcome.
      –Simulate having 1st child a boy or girl and 2nd child a boy or girl
      –Simulate taking classes in college 1st semester night or day class, 2nd semester night or day class
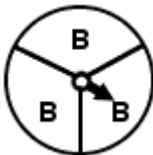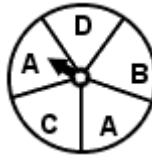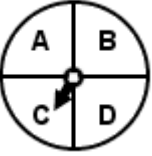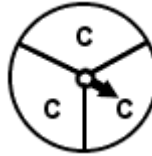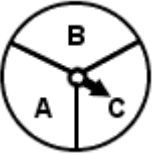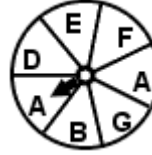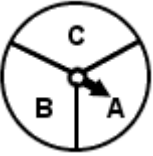
Station #2
Device: Spinner
Complete the following 20 problems.
**Worksheet Courtesy of edHelper.com
Part 1: Write the probability of spinning each letter.

1.	2.	3.	4.
The letter *C*. ____ out of ____	The letter *A*. ____ out of ____	The letter *B*. ____ out of ____	The letter *B*. ____ out of ____
3/6 or 1/2	1/5	3/3=1	1/5

5.	6.	7.	8.
The letter *E*.	The letter *E*.	The letter *A*.	The letter *F*.
____ out of	____ out of	____ out of	____ out of
____1/5	____1/5	____2/6 or 1/3	____1/8
9.	10.	11.	12.
The letter *C*.	The letter *C*.	The letter *B*.	The letter *C*.
____ out of	____ out of	____ out of	____ out of
____1/4	____1/5	___1/6_	____3/3
13.	14.	15.	16.
The letter *G*.	The letter *B*.	The letter *D*.	The letter *F*.
____ out of	____ out of	____ out of	____ out of
____1/7	____1/3	__1/8__	____1/7
17.	18.	19.	20.
The letter *C*.	The letter *A*.	The letter *F*.	The letter *F*.
____ out of	____ out of	____ out of	____ out of
____2/6=1/2	____1/3	____2/7	____3/6=1/2

4. What numbers was there an equally likely chance of each letter being chosen?
   2,3,5,6,9,10,12,13,14,16,18

5. Which problems had a greater chance of a certain letter being chosen and why?

   Numbers 3 and 12 because each section was the same letter. Also, the problems where a letter appeared more than once on the spinner.

6. How could you use spinners to predict outcomes of different events? Give at least two examples and the rules for using the spinner.
   Spinners can help predict what color car you may want to buy and who you will pick first for a sports team. There are obviously several other possible answers.

Part2:

Use the four–sided spinner provided in order to create a simulation that will help you decide what restaurant to go to for dinner tonight. The four restaurant choices are Chili's, Fridays, Ruby Tuesday and Applebee's.

- Write the rule you will use for the spinner.
      Chili's is 1, Friday's is 2, Ruby Tuesday is 3 and Applebee's is 4.
- Each person will spin 10 times to conduct the simulation. Write your responses in the table below.

Spin	Name:	Name:	Name:	Name:
1	3	3	3	3
2	2	2	2	3
3	1	2	1	1
4	4	3	4	3

3. What is the experimental probability for each restaurant?

Chili's   12/20   Fridays 9/20   Ruby Tuesday   5/20   Applebee's 14/20

4. Based on your simulation, what restaurant will you be eating at tonight?
           Applebee's

Station #3
Random Number Table

http://www.mrs.umn.edu/~sungurea/introstat/public/instruction/ranbox/randomnumbersII.html

Above you will find the link to the random number table that is located at your station; you will need this table for this activity!

Kelly has the best big brother in the world, Josh. He takes her to the grocery store and buys her gumballs because he knows it is her favorite treat. She likes to watch it go down the slide! Today they are at the grocery store and as usual and Josh buys Kelly a gumball. Kelly wants to know what the chances are of her getting a pink gumball. Josh knows there are seven colors and each gumball has an EQUALLY LIKELY chance of being chosen

Help Josh figure out how to predict how many times he has to buy gumballs until he has a pink one.

2. How could you design a simulation to help Josh do this?

Use a spinner with each gumball color in a section
Random number generator or random number table.

Out of all of the simulation devices to use, the most effective one would be a random number table. This is faster than the others because all you have to do is assign a number to each color.

There are seven colors of gumballs, you need to assign a number to each color listed below (hint: start with 1)

Red = 1
White
Blue
Pink
Green
Yellow
Orange

Now let's begin the simulation.

7. Place the random number table in front of you. Close your eyes and place your pointer finger on any spot on the paper.

Wherever your finger falls is the number you will begin with. Use the table below to help record your data.

Example: If your finger lands on 1 this represents a red gumball. You would place a tic mark next to the red gumball column and continue onto the next number to the right and continue until your group has **40** total tic marks.

Before you continue answer the following question…

8. Do you notice that it only includes the numbers 0–9? In the simulation you created you should have gone from #'s 1–7. What happens if in your line of numbers you hit an 8 or 9?

Trial	Results	Frequency
Red		4
White		12
Blue		8

Pink		1
Green		10
Yellow		2
Orange		3
Total		**40**

9. Which color gumball has the highest probability of being chosen based on your simulation? White

10. Based on the data collected, what is the probability that Josh will buy Kelly a Pink gumball when they go to the grocery store? 1/40

11. What is the theoretical probability for each gumball chosen? Remember each has an equally likely chance of being chosen.
    Red=   4/40   White= 12/40   Blue= 8/40   Pink= 1/40   Green=10/40

                    Yellow=2/40   Orange=3/40

12. Compare your experimental probability to the theoretical probability in the table below. Have students write out the comparisons below

Color	Experimental Probability	Theoretical Probability
Red	4/40	1/7
White	12/40	1/7
Blue	8/40	1/7
Pink	1/40	1/7
Green	10/40	1/7
Yellow	2/40	1/7
Orange	3/40	1/7

7. Should the experimental and theoretical probability be close to each other? Yes, if you do enough trials.

8. How could we get a closer match between the theoretical probability and the experimental probability? Create more trials because of the Law of Large Numbers.

Station #4
Randomly Choosing out of a bag

You see in front of you a brown paper bag. DO NOT look inside of this bag! Inside there are several different colors of Jolly Rancher candy. Follow the directions step by step in order to complete this station successfully.

6. Each person in your group will pick a candy out of the bag 10 times and record the results in the table provided below: (Hint: Make sure your column has a total of ten trials.)

Color Jolly Rancher	Person 1	Frequency	Person 2	Frequency	Person 3	Frequency	Person 4	Frequency
Red		1		2		3		0
Green		3		2		3		3
Purple		4		3		2		1
Yellow		1		2		1		2
Orange		1		1		1		4
Total		10		10		10		10

7. Total the number of each color Jolly Ranchers chosen:

   Total Red: 6   Total Green: 11   Total Purple: 10

   Total Yellow: 6   Total Orange: 7

Still not allowed to look in the bag!!!

8. Combine all of your teams' trials, and calculate the <u>experimental probability</u> of choosing each color Jolly Rancher. Use the totals from step 2 to help you.

   Red: $\dfrac{6}{40} = \dfrac{3}{20}$ Green: $\dfrac{11}{40}$ Purple: $\dfrac{10}{40} = \dfrac{1}{4}$ Yellow: $\dfrac{6}{40} = \dfrac{3}{20}$

   Orange: $\dfrac{7}{40}$

9. Now, LOOK INSIDE THE BAG. Take out all of the candies and write down the <u>theoretical probability</u> for each of the candies.

Red: $\dfrac{1}{15}$ Green: $\dfrac{6}{15}$ Purple: $\dfrac{5}{15} = \dfrac{3}{5}$ Yellow: $\dfrac{1}{15}$ Orange: $\dfrac{2}{15}$

10. How did the theoretical probability compare to the experimental probabilities? It may help to re–write the fractions in #3 and #4 as percentages.

Most of the probabilities were within 8 percent of one another.

Station # 5

Number Cube

Part 1:

You have a big date tomorrow night with the person who you have had a crush on all year. It is very important that you look your absolute best! However, you have so many great outfits it is hard to choose which one to wear on the date. Your friends are no help and your parents have no style, it is up to you to decide. You need to decide between 6 shirts and 4 bottoms.

Knowing you are bad at making a decision, your best friend gave you an idea. They said to use a 6–sided number cube to help decide on the outfit you will wear tonight. You will roll the number cube a total of 20 times to help you decide first on the shirt then on the skirt. (Luckily everything goes together so you will match). Whatever shirt and bottom are rolled the most are the two pieces you will wear tonight.

- Explain the rule you would use when rolling the number cube to decide what to wear tonight.

  1st roll for Shirts   2nd roll for bottoms

  #1–6 represent shirts   #1–4 represent bottoms

- Are there any numbers on the number cube that you will disregard and not use in the simulation? If so, why?

  You will not use numbers 5 and 6 when you roll the number cube to represent the bottoms because there are only 4 bottoms.

- Each group member will roll the number cube 5 times for each piece of clothing, the shirt and the bottom.

Record your results in the table below

Shirt & Bottom # Assignments	Person 1		Person 2		Person 3		Person 4	
	Shirt	Bottom	Shirt	Bottom	Shirt	Bottom	Shirt	Bottom
1								
2								
3								
4								
5								
6								

- What shirt and what bottom will you wear for your date tonight?
  You will wear bottom 2 and shirt 4.

Part 2:
Create two new simulations that could be used in a real life situation.
- Simulation 1 *uses all of the numbers* on the 6–sided number cube.
- Simulation 2 *does not use all of the numbers* on the number cube. Please be sure to explain what happens if you land on a number that is not assigned to something in your simulation
  Chose between six names for a child or pet.
  Choose between six restaurants for dinner.
  Choose between a light turning red, yellow or green and disregard three of the numbers on the number cube.
  Choose which homework assignment you want to complete out of the four you have tonight and disregard two of the numbers on the number cube.

Station #6

Deck of Cards

Larry is going to Bubba's Buffet for dinner. He loves this buffet and always has a hard time deciding what to eat. Your job is to help Larry create a simulation using his lucky pack of playing cards that he keeps in his back pocket at all times.

He has four categories of food at the buffet to choose from. Larry wants to pick one item from each category. They are as follows.

Entrees	Side Items	Salad Dressings	Desert
Steak	Baked Potato	Ranch	Chocolate Cake
Chicken	French Fries	Blue Cheese	Apple Pie
Pork Chops	Rice	Italian	Brownies
Hot Dog	Broccoli	French	Sundaes
Hamburger	Corn on the Cob	Thousand Island	Chocolate Pudding

Pizza	Baked Beans	Caesar	Strawberry Shortcake
Spaghetti	Mashed Potatoes		Cheesecake
Roast Beef	Grits		
	Garlic Bread		
	Steamed Veggies		

You need to use his lucky playing cards to help him decide what items he will get on his first trip to the buffet.

Part 1:

4. How would you create the simulation so that he only gets one item from each category? (Hint: use the card suits Spades, Hearts, Diamonds and Clubs) The first column is started for you, please continue from there and fill in the other three columns.

Record your rules below:

Hearts Entrees	Spades=Sides	Diamonds=Dressing	Clubs= Desert
2 Steak	2 Baked Potato	2 Ranch	2 Chocolate Cake
3 Chicken	3 French Fries	3 Blue Cheese	3 Apple Pie
4 Pork Chops	4 Rice	4 Italian	4 Brownies
5 Hot Dog	5 Broccoli	5 French	5 Sundaes
6 Hamburger	6 Corn on Cob	6 Thousand Island	6Chocolate Pudding
7 Pizza	7 Baked Beans	7 Caesar	7Stawberry Shortcake
8 Spaghetti	8 Mashed Potatoes		8 Cheesecake
9 Roast Beef	9 Grits		
	10 Garlic Bread		
	J Steamed Veggies		

5. From question #1 does each item in the category have an equally likely chance of being chosen? Yes

6. What if Larry shuffled all of the cards together and chose four cards randomly from the pile, how will this effect his buffet selection?

He could get three entrees and one desert; he could get the entire same category. He is no longer guaranteed to get one item from each category.

Part 2:

Now, you will simulate what Larry will eat for his first trip up to the buffet. Each person in the group needs to conduct five trials. That means take one card from each pile, replace the card after you recorded the result, shuffle the deck and begin again.

Remember to keep each category of cards separated so there is one item from each category selected!

When you are finished there should be 20 total items chosen from each category.

Entrees	Frequency	Side Items	Frequency	Salad Dressings	Frequency	Desert	Frequency
Steak		Baked Potato		Ranch		Chocolate Cake	
Chicken		French Fries		Blue Cheese		Apple Pie	
Pork Chops		Rice		Italian		Brownies	
Hot Dog		Broccoli		French		Sundaes	
Hamburger		Corn on the Cob		Thousand Island		Chocolate Pudding	
Pizza		Baked Beans		Caesar		Strawberry Shortcake	
Spaghetti		Mashed Potatoes				Cheesecake	
Roast Beef		Grits					
		Garlic Bread					
		Steamed Vegetables					

Based on your simulation,

5. What Entrée will Larry eat first?

6. What Side item will Larry eat first?

7. What Salad Dressing will Larry eat?

8. What desert will Larry Eat?

Station # 7

Number Cube

Materials: miniature cars, a race board, and number cube

Part 1: ALL OF THE EXPERIMENTAL PROBABILITY ANSWERS WILL VARY

Given a race board and different colored cars, you will play against a partner to win the race in **3 or 1** moves (read directions in each question–it changes!). Note you may only move by rolling a number cube, and there are specific rules which change in each question! Complete the following four questions:

Note: Make sure you do several trials for the experimental probability, at least 10 trials for each.

5. If the blue car is allowed to move on rolls of 2, 5, and 6 and the red car is allowed to move on rolls of 1, 3, and 4 which car is more likely to finish a 3 step race first?

        a. What is the theoretical probability the red car will finish first? _____1/2__

        b. What is the experimental probability of the red car finishing first? _____

        c. What is the theoretical probability that the blue car will finish first? __1/2_

        d. What is the experimental probability of the blue car finishing first? __

        Explain your answer :

6. If the red car is allowed to move on rolls of 1 and 6 and the blue car is allowed to move on rolls of 2, 3, 4, and 5 which car is more likely to finish a 1 step race first?

        a. What is the theoretical probability the red car will finish first? _____2/6__

        b. What is the experimental probability of the red car finishing first? _____

        c. What is the theoretical probability that the blue car will finish first? __4/6_

        d. What is the experimental probability of the blue car finishing first? _____

        Label and Show Your Work

7. If the blue car is allowed to move on rolls of 3 and the red car is allowed to move on rolls of 1, 2, 4, 5, and 6 which car is more likely to finish a 1 step race first?

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a. What is the theoretical probability the red car will finish first? _____5/6_____

b. What is the experimental probability of the red car finishing first? _____

c. What is the theoretical probability that the blue car will finish first? __1/6_

d. What is the experimental probability of the blue car finishing first? _____

Label and Show Your Work

8. If the red car is allowed to move on rolls of 1 and the blue car is allowed to move on rolls of 2, 3, 4, 5, and 6 which car is more likely to finish a 1 step race first?

a. What is the theoretical probability the red car will finish first? _____1/6_____

b. What is the experimental probability of the red car finishing first? _____

c. What is the theoretical probability that the blue car will finish first? __5/6_

What is the experimental probability of the blue car finishing first? _____

Label and Show Your Work

Teacher note afterwards:

  o Ask the class what they think caused the discrepancies in their experimental results and their theoretical results.
  o Ask the class if they believe performing the experiment more times would make their experimental results closer to the theoretical results.

Ask them how long they think it would take them to perform that experiment 10,000 times.

Introduction to Designing Simulation

Name: _____

Date: _____

Fran Fresh loves fast food. She really likes the toys in Burger Boys kid's meals. They have a new line of toys that have five different characters. Obviously, Fran wants to collect all five.

Your job is to help Fran predict how many kid's meals she will need to buy in order to get all five toys.

You will be working with a partner please list the partners below:
Partner #1:
Partner #2:

Part 1: **Together in class**

- What random device will you use to simulate the situation?

- How will you use this device?

- What does one trial represent? Will there be a set number of outcomes in each trial?

- How will you conduct one trial?

- What would be the most ideal or "perfect" result for one trial?

Part 2: Conducting the simulation

You and your partner are going to conduct the simulation that you designed. You will conduct *10 trials each*, so *20 trials total*. Please record your outcomes in the table below.

Trial	List Outcomes from Trial	Total # of Outcomes
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Part 3: Recording Results

Number of kid's meals purchased in order to get all five toy characters	Frequency of times #meals bought occurred
Example: **22** kid's meals purchased	Occurred: in **3** simulations
Total Trials	**20**

Name: __ANSWER KEY___
                                                                                     Date: _____

Fran Fresh loves fast food. She really likes the toys in Burger Boys kid's meals. They have a new line of toys that have five different characters. Obviously, Fran wants to collect all five.

Your job is to help Fran predict how many kid's meals she will need to buy in order to get all five toys.

   You will be working with a partner please list the partners below:
   Partner #1:
   Partner #2:

Part 1: **Together in class (take several ideas so if groups struggle then every group will be on the same page)**

- What random device will you use to simulate the situation?

  Several answers are fine, spinner, random number table or random number table, or number cube.

- How will you use this device?
  Direct the students to use a random number generator. Make sure you have a discussion about the effectiveness of this device as opposed to the others. Let 0–4 or 1–5 represents each toy. Make sure you show the steps to using the random number generator on the calculator.

- What does one trial represent? Will there be a set number of outcomes in each trial?

          One trial represents the number of times it took to generate the numbers in order for each toy to appear at least once.

- How will you conduct one trial?

  RandInt {1, 5} hit enter and record the number. Keep hitting enter and recording data until all numbers appear at least once.

- What would be the most ideal or "perfect" result for one trial?

          Five numbers in one trial would be a perfect result because each prize appears once and she will have her complete collection.

Part 2: Conducting the simulation

You and your partner are going to conduct the simulation that you designed. You will conduct *10 trials each*, so *20 trials total*. Please record your outcomes in the table below.

Trial	List Outcomes from Trial	Total # of Outcomes
1	1 1 4 4 1 4 3 5 5 3 2	11
2	3 4 3 4 2 3 2 1 5	9
3	5 3 1 1 4 5 5 5 5 2	10
4	3 3 3 2 3 2 4 5 2 2 5 3 3 2 4 2 3 2 1	19
5	2 2 3 1 2 2 4 4 1 1 1 4 5	13
6	5 4 3 3 1 5 5 4 5 1 1 5 1 3 3 4 2	17
7	4 5 3 2 4 1	6
8	5 4 3 2 5 1	6
9	1 2 4 1 1 5 2 5 1 4 1 4 1 3	14
10	2 5 1 1 1 5 3 5 5 1 4	11
11	1 1 2 1 2 2 4 5 2 4 4 1 1 2 3	15
12	1 3 2 3 1 1 4 4 2 1 3 2 4 4 2 2 5	17
13	5 5 5 1 2 5 5 4 5 3	10
14	3 3 5 1 1 1 5 4 2	9
15	5 4 5 4 3 5 1 4 4 5 5 5 5 4 5 1 1 5 2	19
16	4 3 1 4 1 3 3 3 5 2	10
17	5 1 3 3 1 4 4 1 1 4 4 4 4 3 3 2	16
18	5 2 5 4 3 5 4 2 5 5 2 4 3 1	14
19	1 1 4 2 3 5	6
20	4 5 2 5 3 4 2 2 5 2 4 1	12

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Part 3: Recording Results

Number of kid's meals purchased in order to get all five toy characters	Frequency of times #meals bought occurred
Example: **22** kid's meals purchased	Occurred: in **3** simulations
6	3 times
9	2 times
10	3 times
11	2 times
12	1 time
13	1 time
14	2 time
15	1 time
16	1 time
17	2 times
19	2 times
Total Trials	**20**

Let's Race   Name: _____
Probability Simulation   Date: _____

David and George go to the arcade every Friday night. Each time they go they play their favorite racecar game Burn Rubber. Burn Rubber race game has six different courses that are randomly chosen when the player puts the tokens into the machine. David and George want to race on all six courses. Your job is to design a simulation for your friends that will help them predict the number of times they will have to race in order to race on all six courses.

You will be working with a partner please list the partners below:

    Partner #1:
    Partner #2:

Part 1: Designing the Simulation:

- What random device will you use to simulate the situation?

- How will you use this device?

- What does one trial represent? Will there be a set number of outcomes in each trial?

- How will you conduct one trial?

- What would be the most ideal or "perfect" result for one trial?

- Predict the number of times it will take you to draw the toys out of the bag in order to get all six.

Part 2: Conducting the simulation

You and your partner are going to conduct the simulation that you designed. You will conduct *10 trials each*, so *20 trials total*. Please record your outcomes in the table below.

Trial	List Outcomes from Trial	Total # of Outcomes
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

Part 3: Recording Results

Number of Races Played in order to play all 6 courses	Frequency of times #races occurred in your simulation
Example: 22 races	Occurred: in 3 simulations
Total Trials	20

Part 4: Comparing results using measures of central tendency

- What was the mode of the frequency of the data?

- What was the mean of the frequency of the data?

- What was the median of the frequency?

- Did any of the measures of central tendency match your predictions?

Let's Race   Name: ____ANSWER KEY_
Probability Simulation   Date: _____

David and George go to the arcade every Friday night. Each time they go they play their
favorite racecar game Burn Rubber. The race game has six different courses that are
randomly chosen when the player puts the tokens into the machine. David and George
want to race on all six courses. Your job is to design a simulation for your friends that
will help them predict the number of times they will have to race in order to race on all
six courses.

You will be working with a partner please list the partners below:

    Partner #1:
    Partner #2:

Part 1: Designing the Simulation:

- What random device will you use to simulate the situation?

      Random Number Generator

- How will you use this device?

      0–5 or 1–6 represents each course

- What does one trial represent? Will there be a set number of outcomes in each
  trial?
      One trial represents the number of times it took to generate the numbers in
      order for each course to appear at least once.

- How will you conduct one trial?
                  RandInt {1, 6} hit enter and record the number. Keep hitting enter
                      and recording data until all numbers appear at least once.

- What would be the most ideal or "perfect" result for one trial?

          Six numbers in one trial, when each number appears once.

- Predict the number of times it will take you to draw the toys out of the bag in
  order to get all six.

Part 2: Conducting the Simulation SAMPLE TRIAL RESULTS

You and your partner are going to conduct the simulation that you designed. You will conduct *10 trials each*, so *20 trials total*. Please record your outcomes in the table below.

Trial	List Outcomes from Trial	Total # of Outcomes
1	6 5 6 2 5 4 6 5 4 5 4 4 3 1	14
2	1 2 1 5 2 2 5 1 4 3 6	11
3	2 3 2 4 6 6 4 1 5	9
4	1 3 4 6 1 1 1 5 2	9
5	6 3 4 3 2 6 1 5	8
6	5 3 6 4 3 5 4 3 3 3 1 3 4 4 2	15
7	3 4 6 3 5 4 5 4 2 5 5 3 5 6 5 2 4 4 6 5 3	23
8	2 2 2 1 6 2 4 4 1 4 5 6 4 1 3	15
9	1 6 4 1 4 5 2 3	8
10	1 3 5 2 1 5 2 6 6 5 4	11
11	3 5 4 3 1 4 1 1 2 5 4 3 6	13
12	2 5 1 5 6 6 5 6 5 2 6 2 6 4 4 3	16
13	6 2 2 5 3 5 2 2 2 3 4 3 1	13
14	3 3 2 6 6 4 5 4 6 5 5 5 5 1	14
15	6 6 1 1 3 1 6 5 3 6 3 6 5 6 2 3 4	17
16	2 6 3 3 5 2 3 5 3 1 2 1 6 2 5 5 1 6 4	19
17	6 2 4 1 5 2 3	7
18	6 4 6 1 5 4 3 3 1 2	10
19	1 5 3 2 1 6 6 1 4	9
20	6 3 6 4 4 6 5 2 3 4 2 3 6 2 6 5 6 5 1	19

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Part 3: Recording Results   SAMPLE TRIAL RESULTS

Number of Races Played in order to play all 6 courses	Frequency of times #races occurred in your simulation
Example: 22 races	Occurred: in 3 simulations
7	1
8	2
9	3
10	1
11	2
13	2
14	2
15	2
16	1
17	1
19	2
23	1
Total Trials	20

Part 4: Comparing results using measures of central tendency

- What was the mode of the frequency of the data?

- What was the mean of the frequency of the data?

- What was the median of the frequency?

- Did any of the measures of central tendency match your predictions?